

**October
2015**



Mponeng Mine Ledging Process and controls

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“Quality of the ledge dictates the efficiency of the stope”



Context

Following a safety strategic workshop held in the first quarter of 2015 and the loss of life, ledging activities were identified as a concern that needed to be addressed and resulted in re-examining of our ledging activities.

- Reviewed ledging procedure
- Reviewed ledging standards
- Series of workshops focusing on:
 - Ledging is set-up work – part of service strategy
 - Ledging is a specialized skill – lost over time
 - Controls, controls and controls!!!!



Backdrop

Where we come from.....

- Ledging not seen as part of stope set up (service strategy)
 - No pre-ledge set up or resourcing thereof
 - Volume driven vs. quality set up (FL pressures)
- Ineffective controls to keep to ledging master plan (coordination of mining sequences)
- Ledging practices and quality deteriorated over time
- Lack of clarity on the overall process and no specific “gate passes”

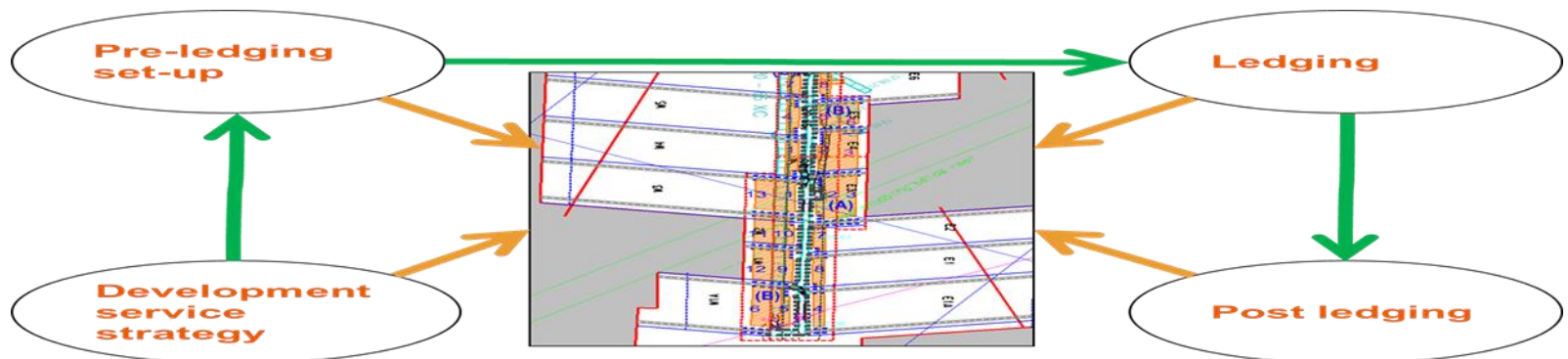
Purpose

- To share the revised Mponeng ledging process and controls implemented in order to effect good mining discipline and coordination of sequences

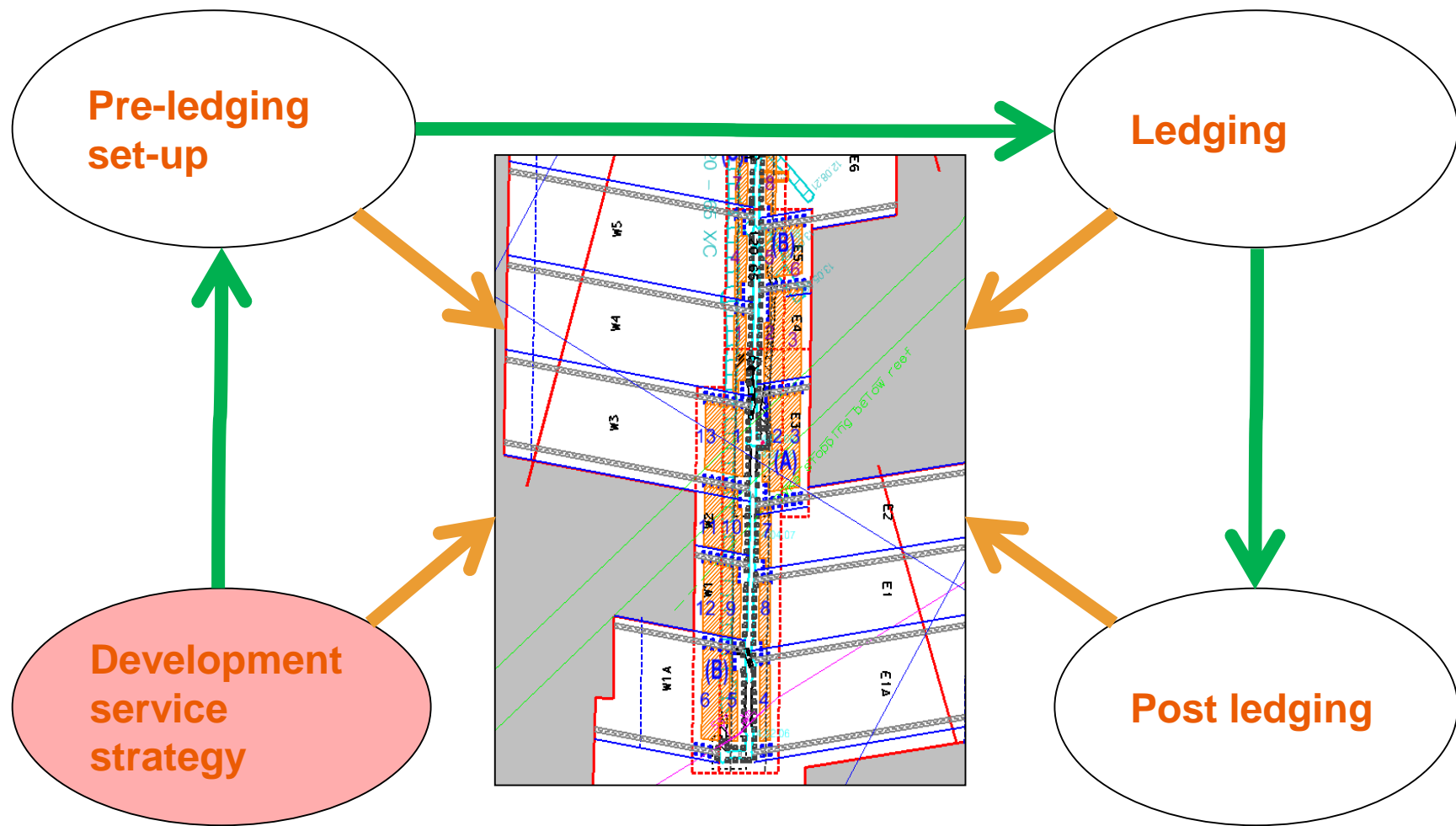


Process and Definitions

- **Development Service Strategy**
 - This is the primary development work and infrastructure set up that needs to be completed concurrently according to **blue-print** before handing over the cross cut and raise for ledging.
 - Cross cut services (Rails, support, boxes, etc.)
- **Pre-ledging set-up**
 - This is the preparatory work in setting up for a safe and efficient ledging process post completion of development work as per blue-print
 - This include the ledging equipping set-up (Cubbies and T/Ways)
- **Ledging execution**
 - Execution of ledging according to the raise specific master plan with key focus on ledging sequence and quality as well as timeous quality support installation.
- **Post Ledging**
 - The aim of a post ledging process is to ensure that all requirements as per the ledging procedure had been met and that the panel can therefore be **authorized** to start mining. These are some of the items inspected:
 - Ledging support sign-off (Stop audits)
 - Equipping sign-off (Winches, grizzlies, etc.)



Development



Development service strategy

- This is the primary development work and infrastructure set up that needs to be completed concurrently according to **blue-print** before handing over the cross cut and raise for ledging.

Key development infrastructure

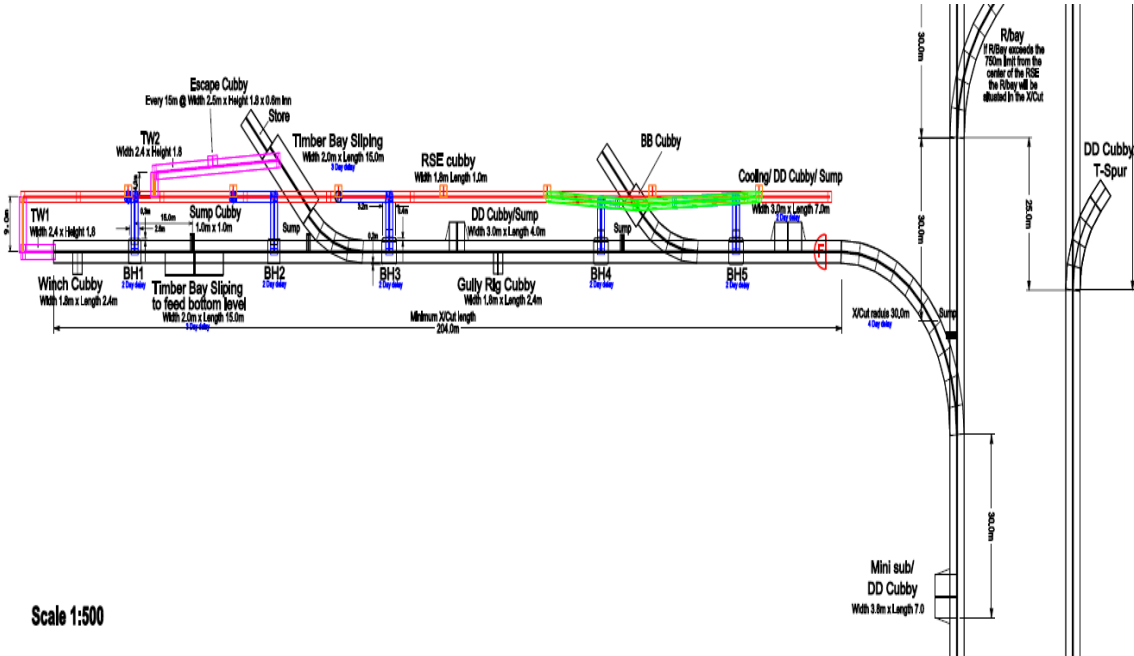
- Flat and incline development
- Timber bay
- Material store
- Waiting place
- Ore pass and slots
- Travelling ways
- Pump sumps
- Material cross cuts and Cubbies (CC, G/Rig , B/Bore)

Key development equipping and construction outcomes

- Cross cut concreted
- Permanent rails
- Pumps
- Geological drilling
- Services
- Secondary support
- Box fronts

Key development controls

- Compliance measurements
 - Quality controllers
 - Survey measuring
- Development Layout approval
- Gate-pass Development/pre-ledge handover

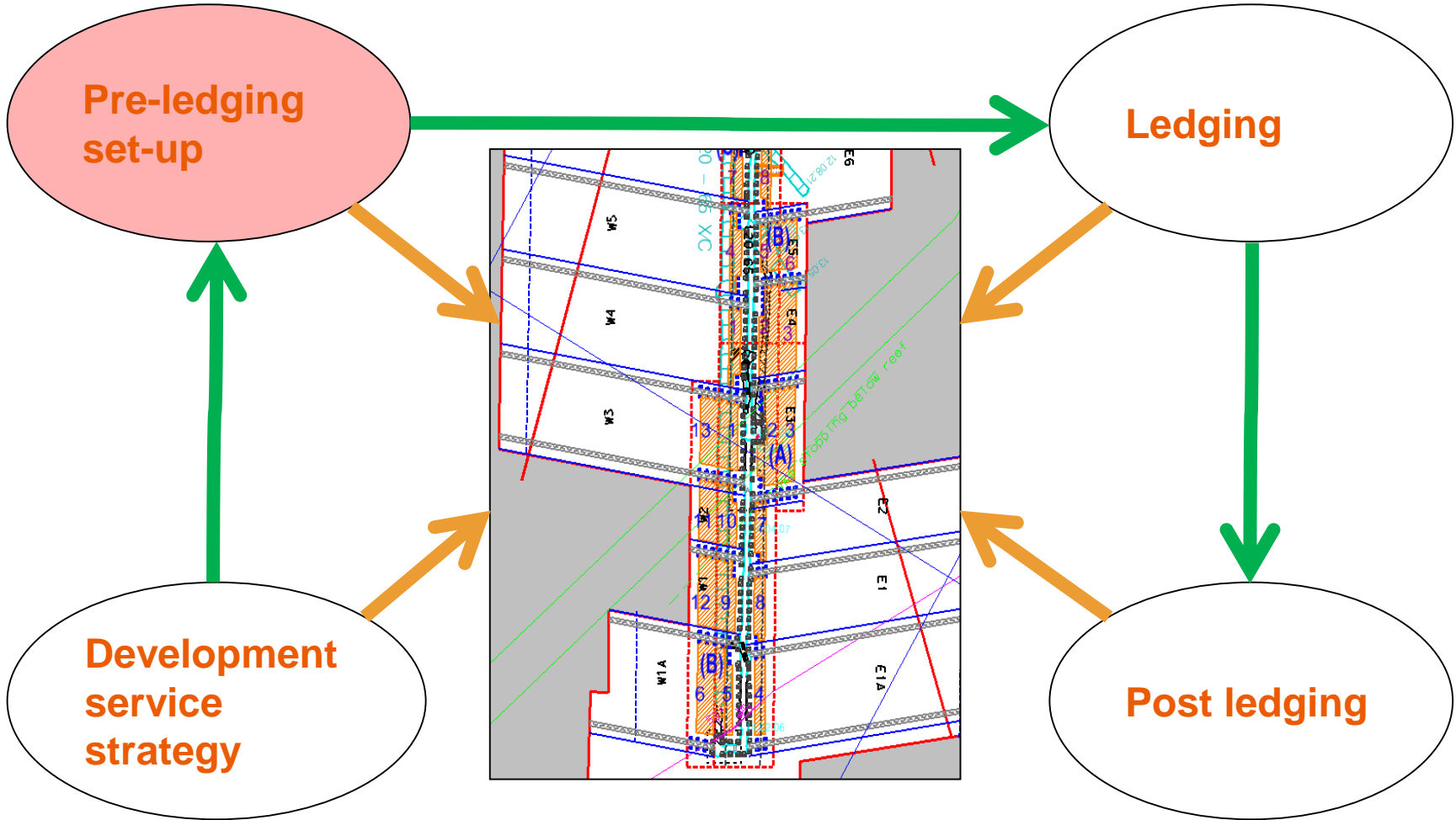


Scale 1:500

Development outcome



Pre-ledge equipping



Pre-ledging set up

- This is the preparatory work in setting up for a safe and efficient ledging process post completion of development work as per blue-print

Ledging project plan

- Multi-disciplinary inspection
- Pre-ledging risk assessment and documentation
- Create a Raise specific 1:200 Master ledging plan and Overlay
- Approval process

Key Pre-ledging set up infrastructure outcomes

- Waiting place
- Explosive boxes
- Mono Winch
- Water jet
- Raise re-support
- Establish T/Way at the raise
- Clean T/way 2 and timber bay
- T/way 2 construction (40 m)
- Mining store construction
- Box 1 Tip construction
- T/way 1 Over stoping Setup
- Box 4 Tip construction
- Waiting place (Top)
- Explosive boxes (Top)
- Mono Winch (Top)
- Surveyed gully position and direction as per blueprint.

Key Pre-ledging set up controls

- System work authorization (WPAS and specific Work order)
- Compliance measurements
 - Quality controllers
 - Survey measuring
- Gate pass Pre-ledge/Ledging handover



Pre-Ledging Inspection and ledging risk assessment

Purpose	Outcomes	Controls
The ledging risk assessment focuses on the raise specific risks associated with the ledging process to inform the raise specific master ledging plan	<ul style="list-style-type: none"> Final blue-print plan sign-off Ledging set-up method Panel specific mining methods to be used (TARP) (Breast/Down dip) Support recommendations 	<ul style="list-style-type: none"> WPAS new workplace block against bookings and WO release prior to sign-off (Risk assessment and Blue print)

Pre-Ledging Inspection

Workplace:									
Date:									
1. Raise dimensions	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7	Panel 8	Panel 9
Height:									
Width:									
Any abnormal raise heights >2.4 meters:									
2. Reef position from hanging wall:									
3. Tendons type									
Tendon support:									
Direction:									
Grouting:									
Tensioning:									
4. Ground condition									
Hanging wall:									
Sockets:									
Sidewall:									
Scaling:									
Fracturing:									
Overhanging face:									
5. Brows / Dykes / Faults									
No. of Brows:									
Thickness:									
Double support:									
In-filling:									
Dykes / Faults:									
Brows, Slips, Faults, Dykes (demarcated):									
Reef thickness:									
Internal waste supported:									

Pre-Ledging Critical Triggers

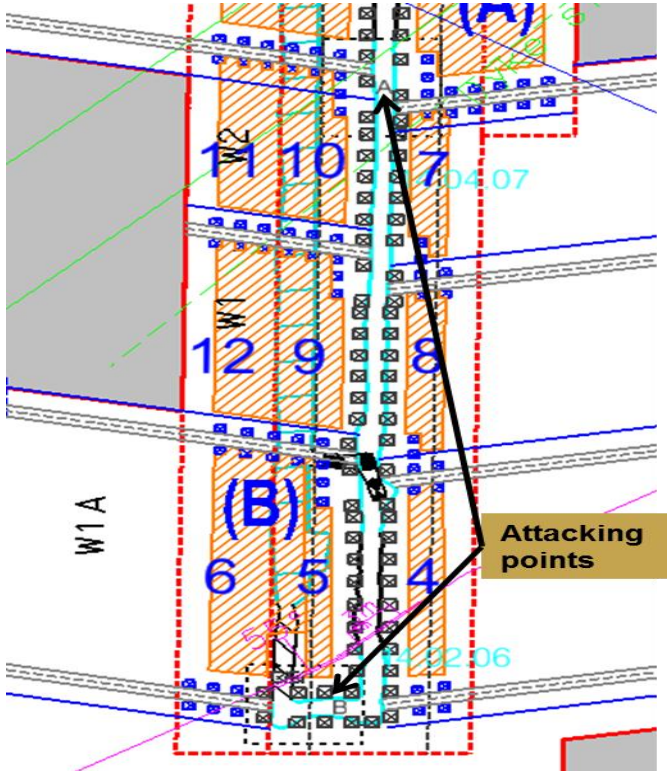
11. Critical triggers	Yes	No
High excavation		
Wide excavation		
Geology intersecting access ways		
Reef in foot, at the top or at the bottom of the raise		
Reef in hanging		
Double reef band		
Rolls >30°		

Pre-Ledging Trigger Action Response

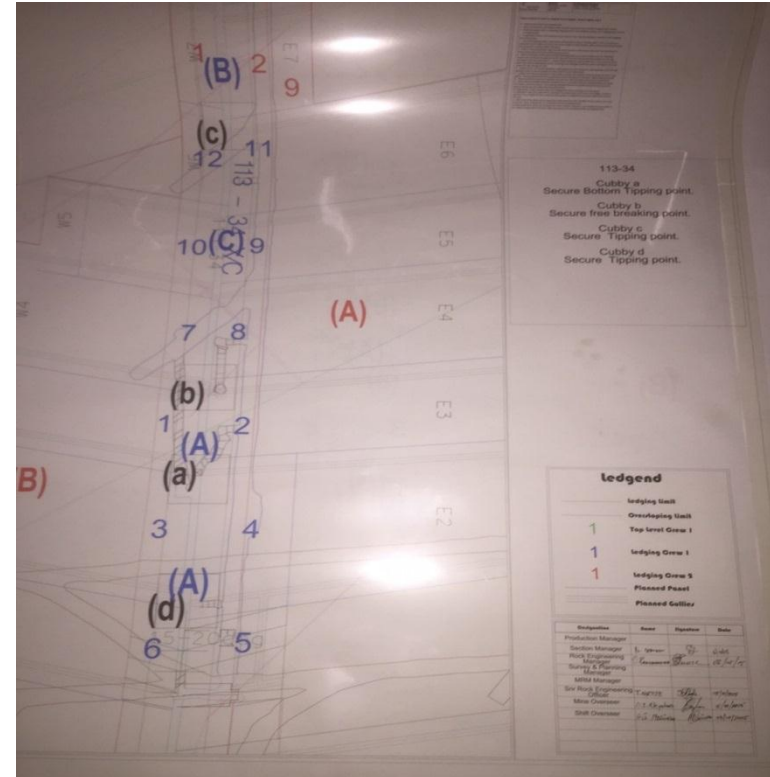
Pre-Ledging Trigger Action Response		
	Triggers	Action Response
A	1. Stopping width 2.4m and less	1. Adhere to standard 18.8 A-D.
B	1. Stopping width is between 2.4m and 3.0m at 2. Inclination between 23° to 35°	1. Adhere to standard 18.8 A-D. 2. Install netting in the hanging wall and along the face. 3. Drill 4 production holes 0.4m effective hole length 0.3m max from h/wall at 0.6m burdens. 4. Drill preconditioning hole 0.6m from the hanging wall contact at 3.0m burdens.
C	1. Stopping width is between 2.4m and 3.0m at 2. inclination >35°	1. Adhere to standard 18.8 A to establish cubbies north and south of the inclined area. 2. Install netting in the hanging wall and along the face. 3. Drill 4 production holes 0.4m effective hole length 0.3m max from h/wall at 0.6m burdens. 4. Drill preconditioning hole 0.6m from the hanging wall contact at 3.0m burdens. 5. Adhere to Down-dip ledging standard 18.19.
D	1. Stopping width is equal or greater than 3.0m at 2. inclination >35° (D)	1. Adhere to standard 18.8 A to establish cubbies north and south of the inclined area. 2. Install netting in the hanging wall and face. 3. Drill 4 production holes 0.4m effective hole length 0.3m max from h/wall at 0.6m burdens. 4. Drill preconditioning hole 0.6m from the hanging wall contact at 3.0m burdens. 5. Adhere to Down-dip ledging standard 18.19.

Pre-ledging set-up Ledging Master Plan

1:200 ledging master plan



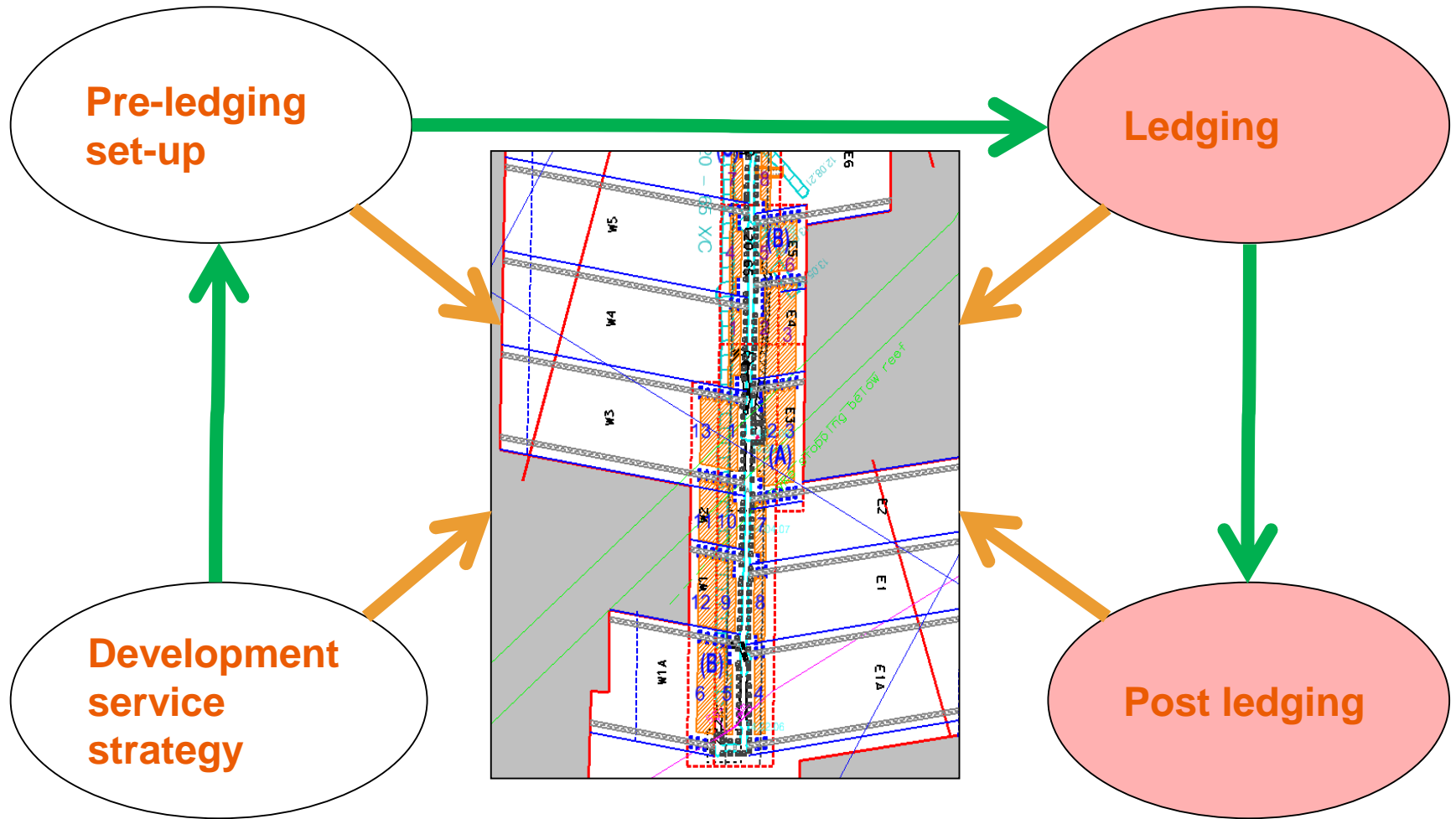
1:200 ledging master plan overlay



- **Raise specific ledging masterplan details**
 - ledging mining method and sequences
 - Limit lines (ledging and overstepping)
 - Support requirements
 - 1:200 plan for monthly execution and plotting
 - 1:200 signed overlay for scrutiny and monitoring compliance to master plan



Ledging and post ledging



Ledging

- Execution of ledging according to the raise specific blue print plan with key focus on ledging sequence and quality as well as timeous quality support installation.

Ledging

Detailed engagement planning with ledging team

- Raise Ledging Master Plan sign off by team
- Method statement
 - First cut
 - Over/Under stoping
 - Travelling way brow
- Ledging standards and procedures

Ledging Outcomes

- Ledging to limit
- Master line support
- Gullies established
- Equipment installed
- In-stope Services infrastructure in place
- Permanent tip construction
- Secured traveling way entrances post overstoping
- Raise Wire Mesh and Laced
- Survey direction line installed in gullies

Ledging controls

- System work authorization (WPAS and Work order)
- Compliance measurements
 - Quality controllers
 - Survey measuring
- Daily plotting on 1:200 plan
- Ledging limit panel stop audit
- Monthly PM scrutiny (master plan overlays)

Proposed controls

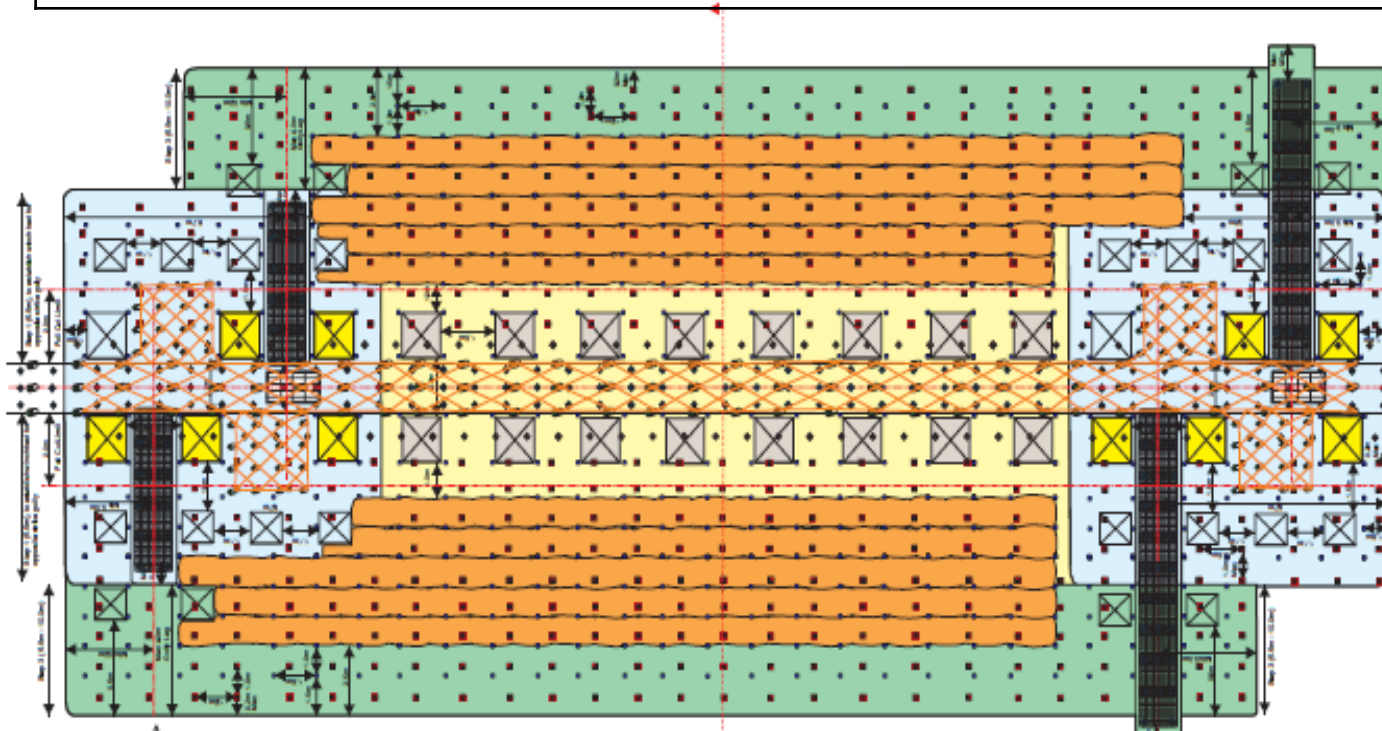
- Revision of Ledging bonus scheme to schedule compliance system
- System control
 - Daily advance bookings to flag at critical position/limit lines
- Gate pass Multi-disciplinary Ledging /Stoping handover and authorization for stoping.



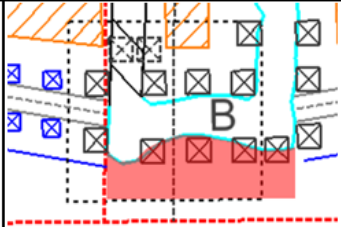
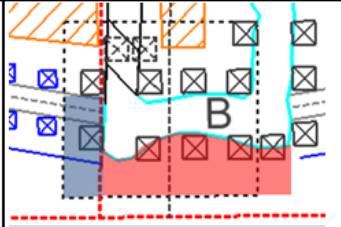
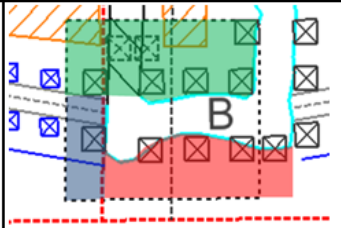
Ledging

Outcomes

- Ledging as per Master Plan
- Gullies established and supported
- All panel established as per the Master plan
- All panel equipped according to standard
- Master line and all support completed



Ledging – specific method statements required

Method Statement: Travelling Way 1 overtopping where travelling way length is minimum 5.0m long					
What	How	Outcome	Hazards	Control to hazards	Picture / Sketch
Down-Dip diagonal face up to 4.0m from diagonal excavation center line.	<ol style="list-style-type: none"> 1. Ensure diagonal excavation 2.2m grouted tendons is installed (3 per ring at 1.5m spacing's along) 2. Full out down-dip ledge from the diagonal excavation hanging wall contact for 4.0m maximum distance from diagonal excavation center line. Install three lines of Rocprop elongates with Loadspreader headboards on the down dip side of the diagonal (1.5m dip and strike spacing's). 3. Install face bolting to mine standard and required spacing's prior to each blast. 4. Install 1.5m x 1.5m packs 1.0m south of the diagonal center line at 1.5m spacing's along. 	Secure and support area along the down-dip side of the diagonal excavation.	Fall of Ground	<ol style="list-style-type: none"> 1. Competent person 'A' Entry and making safe procedure (MP PR 01-01). 2. Barrng procedure (MP PR 10-06) 	 <p>Red Fill - First mining step</p>
Breast mine perpendicular (90°) across the diagonal excavation for 3.0m from diagonal excavation shoulder to create free breaking point.	<ol style="list-style-type: none"> 1. Ensure diagonal excavation 2.2m grouted tendons is installed (3 per ring at 1.5m spacing's along) 2. Full out breast ledge from the diagonal excavation hanging wall contact for 3.0m maximum distance from diagonal excavation shoulder. Install two lines of Rocprop elongates with Loadspreader headboards along the excavation shoulder (1.5m dip and strike spacing's). 3. Install face bolting to mine standard and required spacing's prior to each blast. 4. Install 1.5m x 1.5m pack along the diagonal excavation, 1.5m distance from the blasted faces. 	Secure and support area along the breast side of the diagonal excavation.	Fall of Ground	<ol style="list-style-type: none"> 1. Competent person 'A' Entry and making safe procedure (MP PR 01-01). 2. Barrng procedure (MP PR 10-06) 	 <p>Blue Fill - Second mining step</p>
Up-Dip diagonal face and free face north of 3.0m mined portion up to 4.0m from diagonal excavation center line.	<ol style="list-style-type: none"> 1. Full out up-dip ledge for 4.0m maximum distance from the diagonal excavation center line. 2. Install face netting between the panel face and temporary support line, maximum distance of 0.3m from the face. 3. Install three lines of Rocprop elongates with Loadspreader headboards on the up dip side of the diagonal (1.5m dip and strike spacing's). 4. Install face bolting to mine standard and required spacing's prior to each blast. 5. Install three 1.5m x 1.5m packs 1.0m north of the diagonal center line at 1.5m spacing's along. 6. Install one 1.5m x 1.5m pack 2.0m north of the 1.5m pack that was installed when the free breaking point perpendicular to the diagonal excavation was created. 7. Install two 1.5m x 1.5m skeleton packs on top the created travelling way 1 holding area. 	Secure and support area along the up-dip side of the diagonal excavation (travelling way 1 holding area).	Fall of Ground Rolling stock Steep area High area	<ol style="list-style-type: none"> 1. Competent person 'A' Entry and making safe procedure (MP PR 01-01). 2. Barrng procedure (MP PR 10-06). 3. Steep area procedure (MP PR 01-12). 	 <p>Green Fill - Third mining step</p>

Specific tasks requiring detail

- Over-stopping (Travelling ways and cross cut)
- Under-stopping
- First cut (with and without a breaking point)



Ledging – work in progress

- Develop a ledging training pack
- Set up specialized ledging crews and supervisors
- Appointing a ledging coach
- Ledging training
- Finalization of system controls



The End....

